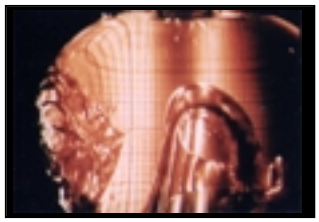
National Aeronautics and
Space Administration

Glenn Research Center

Workshop on Research Needs in Space Thermal Systems and Processes for Human Exploration of Space

July 25 & 26, 2000

Sheraton Airport Hotel
5300 Riverside Drive
Cleveland, Ohio



Sponsored by:

The NASA Office of Life and Microgravity Sciences and Applications

Hosted by:

NASA Glenn Research Center
And
National Center for Microgravity Research on Fluids and Combustion

http://microgravity.grc.nasa.gov/6712/thermal/workshop.html

Objective:
The goal of the workshop is to define specific and cross cutting research needs in the areas of thermal sciences and thermal engineering that will advance the state of knowledge to a level that will enable development of reliable and efficient heat transfer technology for future space and extraterrestrial operations/systems.

Background:
A workshop entitled "Research for Space Exploration: Physical Sciences and Process Technologies," sponsored by the Microgravity Research Division of NASA was held in Cleveland (1997). The heat transfer group discussed basic research needs in four critical areas; surface power, interplanetary travel, in-situ resource utilization, and life support systems. The discussion led to major recommendations for research on thermal engineering, and heat and mass transport phenomena relevant to four critical areas.

Environmental, gravitational, weight, volume, configuration, operational, and safety constraints, and above all cost constraints will dictate the design of thermal systems for space and extraterrestrial operation. An optimum design of any system, no matter how simple, subjected to so many constraints is an extremely challenging problem. This workshop will be centered around focussed discussions on the challenges facing the design/development of improved thermal systems with the objective of defining research needs for critical heat transfer technologies, and heat and mass transport phenomena relevant to:

- Power generation and distribution: chemical, solar and nuclear
- Propulsion: chemical, nuclear, thermoelectric, and solar
- Propellant storage, conditioning and distribution
- Thermal management: on-board and on surface (such as, Lunar and Mars)
- Life support systems: on board and on surface
- In-situ resource utilization: propellant production, consumable production

Approach:
Invite researchers and specialists in thermal sciences, thermal engineering and technical experts on the major space systems from academia, industries, national laboratories and NASA. The workshop will consist of:

- Presentations from NASA mission planners/technical experts, and industry specialists on the major space systems (existing and planned) requirements, operational environments, and constraints which impose the greatest challenges to the implementation of needed capabilities.

- In depth discussion by the expert groups on the critical subsystems, components and the underlying thermal processes. The objective is to identify critical gaps in knowledge and/or lack critical data needed for the design of reliable, efficient, low mass affordable systems.

- Recommendations for specific research topics that will yield the necessary data and/or knowledge.

Outcome:
The desired outcome of the workshop is the generation of a consensus list of prioritized research topics in the areas of thermal sciences and thermal engineering that will impact the development of the next generation space systems by making them more reliable, efficient, and affordable. NASA's Office of Life and Microgravity Science intends to incorporate these recommendations in future NRA's and AO's to support peer-reviewed research in these areas.

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Workshop on Research Needs in Space Thermal Systems and Processes for Human Exploration of Space
Detailed Program

Tuesday, July 25, 2000

Registration and Continental Breakfast 7:00 AM

GENERAL SESSION (Ballroom)

Welcome: 8:00 AM

Gerald J. Barna, Acting Deputy Director, NASA Glenn Research Center

Gerald Pitalo, Enterprise Scientist for Fluid Physics, NASA Headquarters

Simon Ostrach, Director, National Center for Microgravity Research

Recommendations from NRC Report:

Sandra J. Graham, Study Director, National Research Council

Workshop Purpose and Objectives:

Jack A. Salzman, Chief, Microgravity Science Division, NASA Glenn Research Center

Presentations Defining Mission Needs, Roadmap and Challenges

Human Exploration of Space Overview: 8:45 AM

Gary L. Martin, Director, Advanced Projects, NASA Headquarters

Presentations Describing Advanced Concepts/Systems, Heat Transfer Issues, Operating Environments, Constraints, and Critical Elements

Power: 9:15 AM

Requirements, operating environments and constraints
Advanced concepts, Heat transfer issues and challenges.
R. L. Cataldo, NASA Glenn Research Center

Propulsion and Propellant: 9:45 AM

Requirements, operating environments and constraints
Advanced concepts, Heat transfer issues and challenges.
S. K. Borowski, NASA Glenn Research Center

Break (Refreshments) 10:15 AM

ISRU: Propellant and Consumable Production: 10:30 AM

Requirements, operating environments and constraints
P. Kittel, NASA Ames Research Center

Advanced concepts, Heat transfer issues and challenges.
E. E. Rice, ORBITEC

Life support systems 11:00 AM
Requirements, operating environments and constraints
Advanced concepts, Heat transfer issues and challenges.

Thermal Management 11:30 AM
Requirements, operating environments and constraints TBD
Advanced concepts, Heat transfer issues and challenges. TBD

Form Expert Working Groups 12:00 PM

1. Power (Ballroom)
2. Propulsion and Propellants (Stapleton Room)
3. ISRU (Lambert Room)
4. Life support systems (Hartsfield Room)
5. Thermal management (O'Hare Room)

Lunch (Hopkins Room) 12:30 PM

<u>Splinter Sessions with Expert Groups: Identify Critical Elements, Processes, Gaps in Knowledge, Assess Criticality, and Define and Prioritize Research Needs</u>

Splinter Sessions 1:45 PM

Break (Refreshments) 3:15 PM

Splinter Sessions Continue 3:45 PM

Adjourn 5:30 PM

Cash Bar 6:00 PM

Dinner (Hopkins Room) 6:30 PM

Splinter Sessions continue if needed 8:00 PM

Wednesday, July 26, 2000

Continental Breakfast 7:00 AM

Splinter Sessions (conclude activities and prepare presentation for general session) 8:00-8:45 AM

GENERAL SESSIONS: Presentation from Expert Working Groups, Discussion and Consensus Recommendation (Ballroom)

Power - Expert Group lead/representative	9:00 AM
Propulsion and Propellants	9:30 AM
Life Support Systems-Expert Group lead/representative	10:00 AM
Break	10:30 AM
ISRU- Expert Group lead/representative	10:45 AM
Thermal Management-Expert Group lead/representative	11:15AM
Closing Comments	11:45 AM
Adjourn	12:30 PM
Lunch	12:30-1:45 PM